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# INSTITUTE OF GAS TECHNOLOGY

THE GAS INDUSTRY'S OWN EDUCATIONAL AND RESEARCH FACILITY

CHICAGO 16, ILLINOIS

# GAS ABSTRACTS

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# 1. GAS INDUSTRY

## Gas Competition

Shivell, K. B. GAS MAY PROVE A BOON TO OIL. *Fueloil & Oil Heat* 9, 58-60 (1950) *June.*

Gas competition for the house-heating market may benefit the oil burner industry by forcing it to accent the basic advantages which enabled it to capture a large portion of the heating market in the past. The oil heating industry has been hurt by inferior equipment and installations which have fostered public opinion that oil heat is not as clean, convenient or dependable as gas heat. The need for a storage tank can be construed as protection to the home owner insuring a supply when needed.

J. C. Lane

FORUM ON GAS COMPETITION. *Fueloil & Oil Heat* 9, 71-74 (1950) *May.*

The Fuel Oil Distributors Association of New Jersey recently held a four-man panel discussion on gas competition in the house-heating field. The gas industry's close cooperation between burner manufacturers and utility companies was contrasted with the internecine advertising of those oil burner manufacturers whose claims of superiority over all other oil burners discredit the equipment end of the oil industry. The control maintained by gas utilities results in better equipment installations. Where gas utilities service heating equipment, emergency calls are answered 24 hrs per day. To compete with gas, the oil burner sales agencies must operate individually and collectively as a utility, endeavoring at all times to render efficient overall service to the customer. The gas companies cannot take on unlimited new customers because of the limitations on line capacity. Areas which cannot be currently supplied by gas are fertile fields for oil burner installations. Home owners in rural and farm areas are good potential oil burner customers. However, the measure of salesmanship lies in the urban markets where gas is plentiful and gas burners can be installed at lower costs than can oil burners. Gas will cost more per Btu than oil in many Eastern areas, and operational costs may prove a potent argument against lower first costs. The operational economy of oil burner conversion units may be stressed. The peak load problem of the gas industry may be turned to the oil burner salesman's advantage.

J. C. Lane

## LP-Gas

Rugh, K. W. TOTAL LP-GAS SOLD IS TWO-THIRDS OF NATURAL GAS VOLUME. *Butane-Propane News* 12, 66, 69-70, 73 (1950) *June.*

Some 2,725 million gallons of LP-gas were marketed in 1949, representing about 20 gallons per capita of the U.S. population. Of the 28 million homes using gas, about 6.5 million use LP-gas. When the 240 million gallons of LP-gas used in gas manufacturing are added to the quantity used in unconverted form, it is estimated that the LP-gas industry sold 20% more Btu's in 1949 than did the manufactured gas industry and supplied two-thirds as many homes as did the natural gas industry.

J. C. Lane

## Operating Costs

Henry, G. T. INCREASED OPERATING COSTS IS PROBLEM WHICH IS NOT UNSOLVABLE. *Am. Gas J.* 172, 20-21, 44 (1950) *June.*

To maintain and better its competitive position, the gas industry must attract educated personnel to replace retiring executives and operating men. Future profits will be made by the utilities employing men with minds and methods. Utility gas companies may combat today's increased operating costs, and improve their competitive positions by peak-shaving, reduction of unaccounted-for gas, replacement of distribution systems and training salesmen capable of maintaining and expanding existing loads in addition to securing new loads, such as air conditioning, driers and incinerators, which tend to flatten out the peaks. Peak-shaving operations are particularly significant as more utilities convert to natural gas. Reduction of unaccounted-for gas to the minimum may be accomplished employing modern approaches together with regular maintenance of meters and regulators. Planned replacement programs for distribution

systems will insure that utilities are not faced with the necessity of raising the entire capital for replacement at some future time when financial assistance may be difficult to obtain. Increased sales efforts are required to combat electric competition. Since the war, the electric industry has trained 38,000 retail salesmen, compared with 2,150 trained by the gas industry. Gas ranges are now selling at only a 2 to 1 ratio over electric ranges, and 20 times as many electric refrigerators are sold as gas refrigerators.

J. C. Lane

### Petrochemicals

Egloff, G. PETROLEUM CHEMICALS 1950-2000. *Oil Gas J.* 49, 99, 103-105 (1950) *June* 15.

The progress of the petrochemical industry in the period 1900 to 1950 is reviewed. Production for the year 2000 is projected. Of interest is Dr. Egloff's estimate of natural gas production as being 21 trillion in the year 2000.

C. H. Riesz

### Pipe Lines

PROGRESS ON THE PIPELINE: 1950. *Gas* 26, 108, 112, 115 (1950) *May.*

Progress reports of each major pipeline project underway or planned for 1950 are presented together with a map showing their routes.

J. C. Lane

### Range Sales

Klein, J. THE GAP IS CLOSING—WHERE DO WE GO FROM HERE? *Am. Gas Assoc. Monthly* 32, 14, 54-55 (1950) *May.*

The ratio of gas range sales to electric range sales decreased from 14.5 to 1 in 1933 to less than 2 to 1 in 1949. The phenomenal increase in electric range sales is attributed to extensive advertising and aggressive salesmanship. The gas industry must expand its efforts to maintain and extend its competitive advantage.

J. C. Lane

### Regulation

Crosby, S. H. FEDERAL GAS REGULATION: WHAT'S THE SCORE? *Gas* 26, 21-22 (1950) *June.*

It appears that no amendments to the Natural Gas Act will be passed by the 81st Congress before adjournment. A certain crystallization of public opinion is expected to present new barriers to future proposals along the line of the vetoed Kerr bill. Some natural gas men are said to have the attitude that FPC regulation is a stabilizing influence not particularly repressive to the industry in general. Relations between interstate pipe lines and the FPC have been good, and some believe that the FPC will not abuse the potential power which defeat of the Kerr bill has placed in its hands.

J. C. Lane

### Synthetic Fuels

Schroeder, W. C. SYNTHETIC FUEL PRODUCTION. *Petroleum Engr.* 22A, 53, 56, 60, 63-64, 66, 68 (1950) *May.*

New developments in the field of synthetic fuel production are reviewed. A summary of requirements needed to implement a 2 million barrel-a-day synthetic fuel industry indicates a capital investment of $12,200,000,000 and a requirement of 10,200,000 tons of steel. Average cost of the liquid products is 9 cents per gallon exclusive of interest and profit.

C. H. Riesz

## 2. APPLIANCES

### Interchangeability

Knoy, M. F. WHAT'S YOUR QUESTION? I. PROBLEMS OF INTERCHANGEABILITY. *Gas* 26, 31-33 (1950) *May.*

The author gives a brief reply to specific questions on the interchangeability of natural gas with various manufactured gases.

E. F. Davis

## 3. COMBUSTION AND INDUSTRIAL FURNACES

### Boilers

Bergtholdt, G. C., Jr. WHY FORCED DRAFT? *Gas* **26**, 23-24 (1950) *June*.

The author advocates that power burners are not always necessary when converting small boilers to gas, particularly when adequate stacks are available. In other cases power burners should not be installed to give a high combustion chamber pressure but the existing stack should be utilized most effectively.

E. F. Davis

### Burners

Smirles, W. N. MOLDED REFRACTORY BURNERS. *Gas J.* (British) **262**, *Supplement*, 586-592 (1950) *May* 31.

An account is given of the design, construction, and performance of a special type of molded refractory burner to be used for local heating in industrial operations. The burner consists of a short converging tunnel at the base of which theoretical air gas mixtures are burned. The flames are formed at the mouth of a series of slots in the base of the tunnel, which is molded integral with the tunnel walls. The performance of these burners is gauged by the heat imparted to a circular tube across the tunnel mouth, and results are related to standard data on forced convection.

E. F. Davis

THE DELBOURG TEST BURNER. *Gas J.* (British) **262**, 312-313 (1950) *May* 3.

A description is given of a specially designed and constructed gas burner. The primary air is set at a value of 0.8 and the gas pressure is varied to detect flame stability characteristics. Sendout gas composition is controlled by measuring the characteristics on the burner and adjusting gas mixing to give suitable characteristics.

E. F. Davis

### Flame Studies

Arthur, J. R. SOME REACTIONS OF ATOMIC HYDROGEN IN FLAMES. *Nature* (British) **165**, 557-558 (1950) *April* 8.

In hydrogen diffusion flames impinging on solid surfaces, the observed luminescence due to hydrogen atom recombination can be suppressed by certain additives. For each additive, there is a critical amount at which total extinction of the luminescence is obtained. When sodium vapor is present, its characteristic radiation is extinguished at the luminescent extinction point. Luminous hydrocarbon flames are rendered non-luminous by the addition of large quantities of foreign gases; for example, 45% $CO_2$ in $CH_4$ yields a non-luminous diffusion flame, but significant suppression of the light yield is observed at much lower concentrations. The extinction points for carbon luminosity in hydrocarbon flames and for sodium radiation, when present, also coincide. This observation suggests a relationship between hydrogen atoms and luminous carbon formation. The first step in carbon formation may involve the reaction between atomic hydrogen and one of the hydrogens in the hydrocarbon molecule to form molecular hydrogen, or the direct addition of a hydrogen atom to a hydrocarbon double bond. In either case, a hydrocarbon radical is obtained and the polymerization of the freshly formed radicals leads to solid carbon formation and luminous flames.

A. J. Rudnitzki

Reiter, S. H. and Wright, C. C. STABILITY OF BURNER FLAMES WITH PROPANE-HYDROGEN MIXTURES. *Ind. Eng. Chem.* **42**, 691-694 (1950) *April*.

Data are reported on the flame stability of propane, hydrogen and mixtures of propane and hydrogen as postulated by the "critical velocity gradients" of Lewis and Von Elbe. The effect of increasing concentrations of hydrogen in hydrogen-propane mixtures is shown to be nonlinear for both blow off and flashback.

E. F. Davis

### Gas Turbines

Mochel, N. L. METALS FOR GAS TURBINES. *Mech. Eng.* 72, 462-466 (1950) *June.*

A discussion is given on alloys for combustion chamber liners, turbine casings and rotors, blading and buckets, and bolting material. The highest inlet operating temperature for stationary units is in the range of 1350 to 1500°F, for which chrome-nickel alloys find application. Alloy development is considered.

C. Von Fredersdorff

## 4. CARBONIZATION AND GASIFICATION

### Carbonization

Brown, J. M. CARBONIZING IN CONTINUOUS VERTICAL RETORTS. *Gas Times* (British) 63, 376, 381-383 (1950) *June* 2.

Operating practice is described for a continuous vertical retort plant in which the gas-making potential has been increased by 15% by careful attention to uniformity in steaming coke extraction, coal mixing, rodding so that the increased coal gas yield could be blended with producer gas. Tabulated operating and test-run data are given.

O. P. Brysch

### Coal Preparation

Crentz, W. L., Doherty, J. D. and Donath, E. E. COAL PREPARATION FOR SYNTHETIC LIQUID FUELS. *Mining Eng.* 187, 507-510 (1950) *April.*

Purchasers of coal for conversion to synthetic fuels will set new quality specifications of ash and sulfur content which must be met by the preparation plants. The coal cleaning problems are primarily: (1) removal of ash for the Bergius process, in which it would cause deterioration of catalyst, increased servicing costs and decreased oil yields; and (2) removal of sulfur in the Fischer-Tropsch process in which it would cause excessive gas-cleaning costs. The coal cleaning problems are involved with the economies of the two processes in regard to disposal of middlings and to economic limits of ash reduction. Results of a Bureau of Mines study are given for 2.3 and 6.0% ash coal for hydrogenation, expressed as maximum allowable washing costs for each unit of ash reduction and as minimum reduction in ash content to justify a washing cost of 15 cents per ton.

O. P. Brysch

### Coal Tar Research

McNeil, D. THE WORK OF THE COAL TAR RESEARCH ASSOCIATION. *Coke & Gas* (British) 12, 177-181, 185 (1950) *May.*

A description is given of the new laboratories of the Coal Tar Research Association at Gomercal. Among the problems to be investigated include divergencies of raw materials and distilling techniques, disposal of pitch and creosote, and use of new techniques such as catalytic cracking of creosote and tar fractions. Markets are to be developed for such polycyclics as phenanthrene, carbazole, fluorene, and acenaphthene.

W. E. Ball

### Coke in Blast Furnaces

Sanderson, T. and Wattleworth, D. R. THE USE OF COKE IN BLAST FURNACES. *J. Inst. Fuel* (British) 131, 115-120 (1950) *May.*

Blast furnace records extending over a period of 74 weeks were examined statistically to obtain quantitative information concerning the effect of coke quality on furnace performance. Out of 31 factors selected as possibly affecting output of iron per ton of coke, it was found that the $+1\frac{1}{2}$ in. and $-\frac{1}{2}$ in. shatter indices of the coke, as well as its bulk density, were of significance. The mutual relationship between these three factors was such that the $-\frac{1}{2}$ in. shatter index could be used as a measure of coke quality. High carbon, low sulfur, and low volatile matter were found to be desirable in the coke. Alteration of the coal blend, degree of pulverization, and carbonizing conditions resulted in an improved coke, which performed even better than anticipated in the blast furnace.

W. E. Ball

## Coke Ovens

Heuer, R. P. and Grigsby, C. E. PROPER COKE OVEN REFRACTORIES REDUCE OVERHEAD COSTS. PART I. *Steel* 126, 65-68 (1950) May 29; PART II. *ibid* 98-100, 102, 104 (1950) *June* 5.

A battery of coke ovens is one of the most complicated and costly of refractory-lined structures, each oven containing about 40,000 nine-inch equivalents of special fireclay and silica brick. The brick in different parts of the oven are subject to highly variable destructive conditions, such as severe load, high temperatures, thermal shock and abrasion. Analysis of the service conditions shows that silica brick, because of its thermal expansion characteristics, is the most suitable refractory for high-temperature sections of the oven. Fireclay brick is recommended for locations where temperature conditions are not so severe, as in doors, jambs, foundation matt, and top matt. Because of the reversible thermal expansion of silica brick, the inversion temperature range of 390 to 530°F must be passed through very slowly. Used silica brick is even more sensitive to temperature in these ranges than new brick.

W. E. Ball

Padgett, G. COKE OVEN WITH HORIZONTAL REGENERATORS. U.S. 2,501,786 (1950) March 28.

A *vertical* coke oven is described, heated by *superimposed horizontal* combustion flues on both sides of each coking chamber. The unique features are comprised in each flue being independent and *having at each end a regenerator* for heating the air and gas. Each regenerator is divided into four sections so that primary and secondary air, and also primary and secondary fuel gas are heated separately, the *secondary supplies being carried by separate ducts to a point considerably inwards from the regenerator* before they enter the flue to mix and burn. The regenerator space may be filled with multi-wall tile or with spaced slabs. Rich gas may be used as fuel by injecting it through a separate pipe directly to the flues wherein air injection is subdivided, or in a modified construction by diluting it with waste gases aspirated from the opposite regenerator. Half of the horizontal length of the oven is heated during one cycle, then the air-fuel mixture and the waste gases both flow in the opposite direction upon reversal; so that the other half-length is heated.

O. P. Brysch

## Effluents

Wedgwood, P. OPERATION EFFLUENT. *Gas J.* (British) 262, 457-459, 462-464, 468 (1950) *May* 17.

This review of waste liquor disposal gives the history of the subject and emphasizes the pretreatment of liquors necessary before the liquor can be discharged to sewage works. To keep the volume of liquor at a minimum, the smallest possible quantity of liquor should be used in plants employing indirect recovery of ammonia. Objectionable compounds are minimized by keeping oxygen out of the gas up to the inlet of the purifiers, and removing substantially all of the ammonia from the gas.

W. E. Ball

## Gasification

Batchelder, H. R. and Sternberg, J. C. THERMODYNAMIC STUDY OF COAL GASIFICATION. *Ind. Eng. Chem.* 42, 877-882 (1950) *May.*

A method of calculation is presented for the estimation of gas yields, gas composition and heat effects for the suspension gasification of pulverized coal with steam and oxygen. Using the basic assumptions of: (a) thermal balance in the reaction chamber; (b) homogeneous gas equilibrium of the reaction

$$CO + H_2O = CO_2 + H_2;$$

(c) complete utilization of oxygen; and (d) extent of carbon conversion, a series of graphs were prepared for required steam temperatures, gas yield per lb coal, and per cent steam decomposition as function of steam to coal ratio, oxygen to coal ratio and reaction temperature.

C. Von Fredersdorff

## Producer

Galusha, A. L. AGITATOR FOR GAS PRODUCERS. U.S. 2,502,141 (1950) March 28.

A fuel agitator comprising a rotating arm and drive mechanism with provision for raising and lowering within the fuel bed is described. Application to the gas producer is described.

C. Von Fredersdorff

## Purification

Dixon, B. E. and Williams, R. A. REACTION OF IRON WITH MONOETHANOLAMINE. *J. Soc. Chem. Ind.* (British) **69**, 69-71 (1950) *March.*

During experimental work on the absorption of $CO_2$ by MEA in a plant constructed of mild steel it was observed that a mixture of white and dark red crystals formed in the scrubbing liquid upon repeated recycling. Isolation and analysis of the white crystals indicated their composition to be

$$Fe^{III}(NH_2 \cdot CH_2 \cdot CH_2 \cdot O)_3 \cdot 3H_2O,$$

which has the character of an inner complex salt formulated as trisethanolamino-iron. The red crystals were found to be

$$Fe^{III}(OH)_2(NH_2 \cdot CH_2 \cdot CH_2 \cdot O) \cdot \tfrac{1}{2} H_2O$$

and were formulated as dihydroxoethanolamino-iron. Both compounds were synthesized in the laboratory by refluxing a mixture of iron turnings and monoethanolamine for several days. The authors feel that the formation of iron complexes of the type described is probably a major cause of ethanolamine deterioration in scrubbing operations. Furthermore, the presence of appreciable amounts of water leads to troublesome sludge formation. In the author's opinion iron is dissolved directly by displacing hydrogen from the hydroxyl group of ethanolamine; therefore the presence of oxygen appears to be unnecessary for forming the iron complex.

H. Hakewill

Richardson, B. CONDENSATE FROM OXIDE BOXES. *Gas J.* (British) **262**, 513-514 (1950) *May* 24.

From comparison of analyses of condensates from oxide boxes treating gases both with and without ammonia, the author concludes that the ammonia should be kept as low as possible. Ammonia produces a condensate containing soluble ammonium salts while in its absence some loss of iron oxide as ferrous sulfate in the condensate was noted. However, 80% of the HCN was removed with ammonia, compared to only 24% for ammonia-free gas.

W. E. Ball

## Reforming of Hydrocarbons

Hall, E. L. CATALYTIC REFORMING AND THERMAL CRACKING. *Can. Chem. Process Ind.* **34**, 480-484 (1950) *June.*

Processes are described for the production of high-hydrogen gas from light hydrocarbons and steam. A process invented by the author has been in operation for over a year and indicates that gas of 1000 b.t.u. can be produced at the cost of natural gas delivered by pipe line in remote territories.

Author's abstract

Hersfield, S. W. REFORMING OF HYDROCARBONS AS EXPERIENCED BY THE LONG ISLAND LIGHTING COMPANY. Paper presented at the Production and Chemical Conference of the American Gas Association, New York, N.Y., May 22-24, 1950.

Three reforming operations are described. First, butane reforming in a water gas set during the summer months to take advantage of the low price of butane. The butane is introduced in vapor form during the back run for reforming and butane vapor is also used for enriching to 540 Btu/cu ft. The replacement of gas oil and reduction of coke requirements resulted in a saving of 4.8¢/Mcf (based on the following prices: coke, $19.05/ton; gas oil, 8.64¢/gal; butane, 6.0¢/gal). Second, catalytic reforming of propane and butane for peak shaving. This operation has been discussed in detail in a paper given at the 1948 Production and Chemical Conference and the new paper describes some operating problems and their solution. Third, catalytic reforming of natural gas. Anticipated results for reforming natural gas to 540 Btu gas in a plant now under construction are presented.

H. R. Linden

## Smoke Recorder

Von Brand, E. K. APPLICATIONS OF A PORTABLE CONTINUOUS SMOKE RECORDER. *Mech. Eng.* 72, 479-481 (1950) *June.*

The Socony-Vacuum continuous smoke recorder consists of a vacuum pump which draws a continuous sample from the stack, and a moving tape upon which the soot is deposited. The optical density of the deposit is a measure of the smoke content of the entire flue-gas stream. For chart-recording purposes, a supplementary attachment using the photoelectric principle may be connected. The apparatus has been found to be particularly useful in the investigation of processes where there are wide variations in smoke density, such as may be encountered in oil burners.

W. E. Ball

## Tar Dehydration

Sweeney, J. G. REPORT OF TAR DEHYDRATION SUB-COMMITTEE. Paper presented at the Production and Chemical Conference of the American Gas Association, New York, N.Y., May 22-24, 1950.

The latest developments in mechanical tar dehydration, dehydration by spraying hot emulsion into a water layer and chemical dehydration are discussed. Operating problems with continuous centrifuges are reviewed and operating results for a new tar handling plant using the spray-into-water-layer method and serving four 10 foot U.G.I. mechanical sets of 44 MMcf daily capacity are given.

H. R. Linden

## Underground Gasification

Dalin, D. UNDERGROUND EXPLOITATION OF FUEL DEPOSITS. U.S. 2,497,868 (1950) February 21.

Principal objects of this patent are recovery of volatile products from coal without mining and utilizing coal underground for such purposes as the generation of steam. Eight claims were allowed.

J. D. Parent

Fies, M. H. PROGRESS REPORT ON 2nd EXPERIMENT IN UNDERGROUND COAL GASIFICATION. *Power Eng.* 54, 101-102, 122, 124 (1950) *May.*

Following the first experiment in underground gasification begun in September, 1947, the work has continued until in March, 1949 a second more extensive experiment was started. A coal bed 42 inches thick, relatively level, and lying under an average overburden of 150 ft has been gasified for a width of 70 to 75 ft and a length of 300 ft passage. Producer gases of varying compositions were made and although gas quality has not been stressed in the initial experiments, the main difficulty seems to be the by-passing of air through non-reactive bed material resulting in dilution of the make gases. The introduction of fluidized sand into void spaces underground seems to control air by-passing to some extent by directing the air flow toward the burning face. The optimum length of reaction zone passage has not been determined, but it was apparent that the best operating conditions were obtained with the maximum air flow from the present blowers, indicating the need for high temperatures and short residence time. Various ideas for increasing the rate of air flow to the coal, including cyclic operation utilizing adjacent abandoned mines are presented.

C. Von Fredersdorff

## Utilization

Simmonds, W. A. A SURVEY OF RESEARCH PROBLEMS IN THE USE OF TOWN GAS. *Gas Times* (British) 63, 199-202, 205-207 (1950) *May* 5.

The author outlines and discusses many of the research problems in gas utilization which are now being investigated in England and abroad. Fundamentals of combustion, application of mass spectrograph to combustion problems, determinations of combustion characteristics, secondary aeration, combustion space, rate of heat release, convection and radiation data, corrosion and space heating are but a few of the subjects discussed.

E. F. Davis

### Vertical Retort

Duxbury, A. D. THE DRYING-OUT AND LIGHTING UP OF VERTICAL RETORT INSTALLATIONS. *Gas Times* (British) **63**, 208, 213-214, 216 (1950) *May* 5.

Consideration of the expansion characteristics of the crystalline forms and modifications of silica leads to the conclusion that heating must be conducted with caution up to 600°C, and may be more rapid above that temperature. As a general rule, from 32 to 41 days must be allowed for heating up a new retort. Precautions should be taken to heat the setting evenly and equally throughout.

W. E. Ball

The following articles, the abstracts for which appear on the pages indicated, are also called to your attention:

Clark, E. L., Pelipetz, M. G., Storch, H. H., Weller, S. and Schreiber, S. HYDROGENATION OF COAL IN A FLUIDIZED BED. p. 133

Sherwood, P. W. HIGH-PRESSURE HYDROGENATION OF CARBONACEOUS MATTER. p. 134

## 5. NATURAL GAS AND NATURAL GAS CONDENSATES

### Compressor Plants

Goodrich, J. D. FLOATING COMPRESSOR PLANTS. *Oil Gas J.* **49**, 62-63 (1950) *June* 1.

A description is given of two large mounted compressor plants used in gas lift and gas sales operations by Shell Oil Company. One large, 40 ft x 25 ft and 5 ft deep, has a 6 XVG two stage compressor together with all auxiliaries and the second 80 ft x 34 ft and 6 ft deep has two 300 hp compressors. These plants are used in remote swampy areas. A general arrangement diagram of a 1800 hp floating station is included in the article.

O. T. Bloomer

### Dehydration

Miller, E. B. APPARATUS FOR DEHYDRATING GAS AND RECOVERING CONDENSABLE HYDROCARBONS THEREFROM. U.S. 2,507,608 (1950) May 16.

An object of this patent is to remove from natural gas by adsorption not only moisture but some of the liquefiable hydrocarbons. An adsorbent such as silica gel is proposed. Provision is made for regeneration.

J. D. Parent

Hetherington, C.R. MICHIGAN-WISCONSIN'S AUTOMATIC DEHYDRATION PLANT. *Gas* **26**, 131-132, 134, 137, 140, 142 (1950) *May*.

This process is automatic and a feature is that only two units rather than half of the total are out of service at any time, one heating and the other cooling. Less towers are required this way.

J. D. Parent

### Liquefaction

Laverty, F. W. and Cole, A. L. (assignors to Clark Bros. Co., Inc.) LIQUEFACTION SYSTEM. U.S. 2,500,129 (1950) March 7.

This invention relates to the liquefaction of natural gas for storage. The major object is to rid the gas of inert components without losing valuable components. Liquefaction by means of cascade refrigeration is suggested. Following this, the liquid is partially separated by stepwise flashing together with partial condensation of some of the vapor by chilling.

J. D. Parent

### Natural Gasoline

Collum, J. E. and Cook, J. M. and Kilgren, E. W. LEVELLAND GASOLINE PLANT. *Oil Gas J.* **49**, 119-120, 158-159 (1950) *May* 18.

A description with flow diagrams is given of the natural gasoline plant installed to process natural gas from the Levelland oil field in Hockley County Texas. The plant is designed to process 40 MMcf per day. A conventional oil absorption and recovery system is used except that there is only one absorber. The absorber operates at 700 psig and all vent gas from the

stills and deethanizer is recompressed and recycled to the absorber. The field gathering system is designed to collect gas from the field separators operating at 10 psig and deliver the gas to the plant slightly above atmospheric pressure. The gas contains 0.07 mol % hydrogen sulfide and is treated in amine contactors before entering the oil absorber.

O. T. Bloomer

## Production

Barry, A. F. and Parks, A. S. LOW TEMPERATURE SEPARATION. *World Oil* **130**, 203-206, 208, 210 (1950) *June.*

The problem of optimum separator conditions for condensate fluids is discussed. Shrinkage on flashing from the separator must also be considered. Avoidance of hydrates is necessary. An important statement is made: if a free-water knockout is used at well head pressure before expansion little trouble results, even when at 20 to 30 degrees below hydrate forming conditions, but without this device trouble is serious. Flow sheets and process details are given. Package units are in operation.

J. D. Parent

Calhoun, J. C., Jr. ENGINEERING FUNDAMENTALS. PERMEABILITY DISTRIBUTION ARRANGEMENTS. *Oil Gas J.* **49**, 163 (1950) *May* 25.

Statistical treatment of permeability data obtained on a number of samples is discussed. The use of a cumulative frequency curve to break down the data obtained on a large number of cores into district zones of permeability distribution is illustrated.

O. T. Bloomer

Echols, W. H. GAS AND GAS CONDENSATE OPERATIONS FOR THE INDEPENDENT PRODUCER. *Independent Petroleum Assoc. Am. Monthly* **21**, 21-24, 26 (1950) *May.*

Inaccuracies in metering due to corrosion, erosion, warping and deposition of foreign bodies on orifice plates as well as incorrect meter adjustment, chart reading and selection of orifice coefficient are briefly reviewed.

J. D. Parent

Echols, W. H. GAS AND GAS CONDENSATE OPERATIONS FOR THE INDEPENDENT PRODUCER. *Independent Petroleum Assoc. Am. Monthly* **21**, 33-38 (1950) *June.*

The major consideration is procurement of equitable contracts for producers of gas and condensate. Under most plant operations about half of the income from condensate is derived from the sale of liquids recovered. The producer's share under processing contracts lies in the range of 20 to 33½% of the tested liquid content. The recoverable liquid exceeds the tested liquid in the case of condensate due to the difference in operation.

J. D. Parent

Grant, B. F., Duvall, W. I., Obert, L., Rough, R. L. and Atchison, T. C. RESEARCH ON SHOOTING OIL AND GAS WELLS. *Oil Gas J.* **49**, 65-66, 68, 70, 73 (1950) *June* 1.

Current research by the U.S. Bureau of Mines on the problems involved in shooting oil and gas wells is described. The research is based on an experimental study by which the effects on rock of shots fired in shallow drill holes are being evaluated in terms of the strain produced in the rock by the explosion, the change in fluid conductivity of the shot holes, and the physical properties of the rock.

Authors' abstract

Miller, C. C., Dyes, A. B. and Hutchinson, C. A., Jr. APPLICATION OF BUILD-UP CURVES TO DETERMINE RESERVOIR PRESSURE AND PERMEABILITIES. *Petroleum Engr.* **22B**, 7-10 (1950) *June.*

From the rate at which pressure builds up in a shut-in well the effective permeability may be calculated. The permeability may also be estimated from the productivity index based on steady state radial flow; if the former exceeds the latter there is an indication of well damage (lowered permeability near the bore), whereas if the latter is greater there is indication of well improvement. A means of calculating shut-in time for well testing is included.

J. D. Parent

Wortman, H. R. DESIGN OF HEATERS TO ELIMINATE FREEZING AND HYDRATE FORMATION. *World Oil* **130**, 267-268 (1950) *June.*

A simple but effective heater for prevention of hydrates is described. Direct flame impingement is avoided by passing flue gas through an annular space around the gas line.

J. D. Parent

## Purification

Blohm, C. L. and Chapin, W. F. PURIFICATION AND DEHYDRATION OF GASES. *World Oil* **130**, 253-256, 258, 260, 262 (1950) *June.*

Various types of equipment and processes for purifying sour gas are described, and recommendations made as to their use to meet specifications for different uses of the effluent. The authors evaluate glycolamine and monoethanolamine processes and outline uses for them in gas transmission purification setups.

Authors' abstract

*Reviewer's Note:* The authors state that the gas leaving the top plate of the contactor approaches equilibrium with respect to the liquid on the top plate and that any temperature drop will bring condensation of a liquid approximating that on the top plate. The dew point is then not a true water dew point. Actually, the gas leaving any type of absorber is not at equilibrium with the entering liquid unless the tower is infinitely high. Equilibrium composition is approached more closely the taller the tower is and the more effective the liquid-vapor contacting is. No experimental data are available on the composition of dew from glycol-dried gas, but it is known that some glycol collects in gas lines. Also glycol interferes with the proper use of the new Bureau of Mines continuous humidity instrument.

J. D. Parent

## Storage

Johnson, C. B., Jr. UNDERGROUND STORAGE OF LP-GASES . . . SUCCESSFULLY PERFORMED AT CARTHAGE FIELD PLANT OF THE CHICAGO CORP. *Oil Gas J.* **49**, 50-52, 70 (1950) *June* 8.

Fluctuations in the LP-gas market prompted the Chicago Corporation to try underground storage of this material. This was tried in the Carthage field in an area in the Paluxy Sand which seemed to contain only salt water. Conclusions to date are that LP-gas can be withdrawn at will, recovery is more effective when water flood or pumping is used, and that the project is economically attractive.

J. D. Parent

Vandaveer, F. E. and Schmidt, J. J. UNDERGROUND STORAGE AND MIGRATION OF NATURAL GAS. Paper presented at the Production and Chemical Conference of the American Gas Association, New York, N.Y., May 22-24, 1950.

Advantages and cost of underground storage are discussed. Migration tests were performed to determine general information on such items as reservoir boundaries and tightness. The method employed was to check rock pressure, heating value and specific gravity regularly. No increase in rock pressure over a reasonable period of time after injection indicates no migration to the well tested. Mixing can be differentiated from direct displacement by the tests on specific gravity and heating value.

J. D. Parent

## Sulfur Removal

Oberseider, J. L. REMOVAL OF TRACES OF SULFUR FROM NATURAL GAS. Paper presented at the American Gas Association, Natural Gas Department Spring Meeting at Tulsa, Oklahoma, May 8-9, 1950.

The experiences of the Southern Counties and Southern California Gas companies with natural gases bearing excessive quantities of mercaptans, and the effects of excessive mercaptan content on leak complaints and corrosion difficulties are recounted. High mercaptan content appears to be closely associated with high pro-

portions of wet gas-well gas deliveries. If wet gas-well gas cannot be processed in absorption plants, it is necessary to resort to desulfurization methods. Pilot-plant studies of desulfurization were carried out, involving oxidation of the mercaptans with air and/or adsorption on solids, and the effects of significant variables are reported. Engineering and economic evaluations of the pilot-plant data are now being made.

A. J. Rudnitzki

### Transmission

Mast, B. T. COMPRESSION CYLINDER DESIGN FOR GAS TRANSMISSION PIPE LINE SYSTEMS. *Petroleum Engr.* **22D**, 14-16, 18, 20, 22, 24 (1950) *June.*

It is concluded that total clearance should be selected to cover the desired range of compression ratios without the use of clearance pockets.

J. D. Parent

The following articles, the abstracts for which appear on the pages indicated, are also called to your attention:

Dixon, B. E. and Williams, R. A. REACTION OF IRON WITH MONOETHANOLAMINE. p. 126

Glanville, J. W., Sage, B. H. and Lacey, W. N. VOLUMETRIC AND PHASE BEHAVIOR OF PROPANE-BENZENE SYSTEMS. p. 139

Knoy, M. F. WHAT'S YOUR QUESTION? PROBLEMS OF INTERCHANGEABILITY. p. 122

Reamer, H. H., Sage, B. H. and Lacey, W. N. PHASE EQUILIBRIA IN HYDROCARBON SYSTEMS. p. 139

## 6. PETROLEUM AND SYNTHETIC LIQUID FUELS

### Cracking

McKean, R. A. and Grandey, L. F. CONVERSION IN THERMOFOR CATALYTIC CRACKING. *Chem. Eng. Progress* **46**, 245-248 (1950) *May.*

Feed stock conversion has been correlated with space velocity and catalyst-to-oil ratio in Thermofor catalytic cracking of gas oil. The correlation is based on the following empirical formula:

$$C = K_t\, t(1-\sqrt{c}),$$

where C is conversion, t is oil residence time, $K_t$ is a constant for a given feed stock, catalyst-to-oil ratio, reaction temperature and catalyst activity. A similar formula is given in which t is replaced by R, catalyst-to-oil ratio. The two formulae correlate pilot plant and commercial data satisfactorily.

C. H. Riesz

### Fischer-Tropsch Synthesis

Billisoly, J. P. (assigned to Standard Oil Development Co.) HYDROCARBON SYNTHESIS PROCESS. U.S. 2,496,265 (1950) February 7.

For the hydrogenation of carbon monoxide, the preparation of silica gel base or silica alumina gel base catalysts are described and claimed.

C. H. Riesz

Clark, A. (assigned to Phillips Petroleum Co.) SYNTHESIS OF HYDROCARBONS. U.S. 2,497,761 (1950) February 14.

A process is claimed for the catalytic synthesis of higher hydrocarbons from carbon monoxide and hydrogen. The novelty of the invention lies in the recycling of an unsaturated liquid fraction, boiling between 77 and 392°F.

C. H. Riesz

Clark, A. (assigned to Phillips Petroleum Co.) PROCESS AND APPARATUS FOR THE SYNTHESIS OF HYDROCARBONS, U. S. 2,500,519 (1950) March 14.

A reactor suitable for use in the catalytic hydrogenation of carbon monoxide to form hydrocar-

bons contains cooling elements spaced so that the cross-sectional area becomes smaller as the reacting gases proceed from inlet to outlet.

C. H. Riesz

Dart, J. C. (assigned to Standard Oil Development Co.) HYDROCARBON SYNTHESIS OPERATION. U. S. 2,497,932 (1950) February 21.

In the fluidized iron catalyst synthesis of higher hydrocarbons from carbon monoxide and hydrogen, oxygenated compounds are removed from the recycle gas stream first by cooling and then by scrubbing with a solvent such as ethylene glycol.

C. H. Riesz

Frankenburg, W. G. (assigned to Hydrocarbon Research, Inc.) CATALYTIC REDUCTION OF CARBON OXIDE BY HYDROGEN. U. S. 2,507,510 (1950) May 16.

Titanium boride is claimed as a catalyst for the synthesis of liquid hydrocarbons from carbon monoxide and hydrogen at temperatures in the range 500 to 750°F.

C. H. Riesz

Frankenburg, W. G. and Layng, E. T. (assigned to Hydrocarbon Research, Inc.) SYNTHESIS OF HYDROCARBONS AND OXYGENATED HYDROCARBONS. U.S. 2,510,096 (1950) June 6.

In the catalytic synthesis of hydrocarbons from carbon monoxide and hydrogen, the concentration of carbon monoxide is maintained below 15%, the carbon dioxide content is approximately 15% and the water vapor content is less than 1%. The conditions are claimed to provide high conversions of carbon monoxide.

C. H. Riesz

Gillespie, B. G. (assigned to Standard Oil Development Co.) METHOD FOR FORMING SYNTHESIS GAS. U.S. 2,496,342 (1950) February 7.

Methane is reacted with carbon dioxide to form carbon monoxide-hydrogen mixtures in the presence of a catalyst comprising copper carried on activated carbon. The temperature is maintained below 1350°F.

C. H. Riesz

Gillespie, B. G. (assigned to Standard Oil Development Co.) RED-IRON OXIDE TYPE FLUID CATALYST FOR HYDROCARBON SYNTHESIS. U.S. 2,496,343 (1950) February 7.

An iron catalyst suitable for the fluidized synthesis of higher hydrocarbons from carbon monoxide and hydrogen is prepared by sintering at about 1600°F a potassium carbonate promoted red-iron oxide powder.

C. H. Riesz

Griffin, L. I. (assigned to Standard Oil Development Co.) SYNTHESIS OF HYDROCARBONS. U.S. 2,498,838 (1950) February 28.

A fluidized catalyst synthesis of liquid hydrocarbons from carbon monoxide and hydrogen is claimed. The recirculation of scrubbed gas is maintained to give a ratio of total gas recycled to fresh feed which varies between 1.5:1 and 10:1 but may be as high as 20:1.

C. H. Riesz

Hofer, L. J. E., Peebles, W. C. & Bean, E. H. X-RAY DIFFRACTION STUDIES OF THE ACTION OF CARBON MONOXIDE ON COBALT-THORIA-KIESELGUHR CATALYSTS. II. *J. Am. Chem. Soc.* 72, 2698-2701 (1950) *June.*

Below 455 ± 18°F, carbon monoxide reacts with finely divided cobalt to form only cobalt carbide; above this temperature inert free carbon is also formed. The amount of free carbon increases and that of cobalt carbide decreases in reduced cobalt-thoria-kieselguhr catalyst carburized with carbon monoxide at increasing temperatures in the range 470 to 570°F. The free carbon tends to render the catalyst inaccessible to further carbide formation while the presence of carbide inhibits free-carbon deposition.

C. H. Riesz

Kirshenbaum, I. (assigned to Standard Oil Development Co.) HYDROCARBON SYNTHESIS. U.S. 2,509,869 (1950) May 30.

A process for the fluidized synthesis of hydrocarbons from carbon monoxide and hydrogen uses a chromia-supported iron catalyst. The following composition after reduction is specifi-

cally claimed as a catalyst: 80 parts by weight chromia, 20 parts by weight of iron oxide and 2 parts by weight of potassium carbonate.

C. H. Riesz

Krebs, R. W. (assigned to Standard Oil Development Co.) METHOD OF SINTERING A CATALYST. U.S. 2,510,823 (1950) June 6.

By means of a fluidized sintering process, iron catalyst fines are increased in size until suitable for use in the fluidized synthesis of hydrocarbons from carbon monoxide and hydrogen.

C. H. Riesz

Pensel, E. E. and Beck, R. A. (assigned to the Texas Company). METHOD OF CATALYTICALLY SYNTHESIZING HYDROCARBONS. U.S. 2,501,695 (1950) March 28.

For the synthesis of hydrocarbons from carbon monoxide and hydrogen, a bed of powdered catalyst is agitated mechanically in order to permit linear gas velocities below those normally required for fluidization.

C. H. Riesz

Smith, L. B. and Krebs, R. W. (assigned to Standard Oil Development Co.) HYDROCARBON SYNTHESIS REACTION. U.S. 2,498,845 (1950) February 28.

In starting up a fluidized iron catalyst reactor for the synthesis of higher hydrocarbons from carbon monoxide and hydrogen, the reduced catalyst is purged with a methane-containing gas before admission of synthesis gas. Control of the addition of synthesis gas avoids initial overheating of the catalyst.

C. H. Riesz

Summerfield, S. D. (assigned to Standard Oil Development Co.) SYNTHESIS OF HYDROCARBONS. U.S. 2,497,964 (1950) February 21.

The deposition of carbon on a fluidized catalyst of the iron type is minimized by the addition of steam ranging from 0.05 to 0.8 part by volume of the hydrogen contained in the hydrogen-carbon monoxide feed mixture.

C. H. Riesz

White, P. C. (assigned to Standard Oil Co.) SEPARATION OF HYDROCARBON SYNTHESIS PRODUCTS. U.S. 2,501,115 (1950) March 21.

A process is described for the separation and recovery of organic oxygenated compounds and hydrocarbons produced in the catalytic synthesis of liquid hydrocarbons from carbon monoxide and hydrogen.

C. H. Riesz

## Hydrogenation

Clark, E. L., Pelipetz, M. G., Storch, H. H., Weller, S. and Schreiber, S. HYDROGENATION OF COAL IN A FLUIDIZED BED. *Ind. Eng. Chem.* 42, 861-865 (1950) *May.*

Bench scale tests have been made in which small batches (100 grams) of Wyoming bituminous coal, maintained in a fluidized bed, have been hydrogenated. Fluidization was usually effected at a linear velocity of 0.06 foot per second after tests showed no great improvement at higher velocities up to 2 ft per second. Tests were conducted at temperatures of 932°F and 1112°F and at pressures varying from 125 to 1000 psig. Oil yields of 20 to 27% and hydrocarbon gas yields of 20 to 27% were obtained, the yields being based on moisture- and ash-free coal. Fluidized coal hydrogenation thus offers a possible means of dry coal processing at pressures well below those used in standard practice. The use of a catalyst impregnated on the coal should result in a product oil of low asphalt content. A pilot plant at the Bruceton laboratories of the Bureau of Mines is being installed to study the process further.

C. H. Riesz

Columbic, C., Woolfolk, E. O., Friedel, R. A. and Orchin, M. PARTITION STUDIES OF PHENOLS. IV. ISOLATION OF INDANOLS FROM COAL HYDROGENATION OILS. *J. Am. Chem. Soc.* 72, 1939-1942 (1950) *May.*

From a complex phenolic mixture obtained in coal hydrogenation, 4- and 5-indanol have been isolated.

C. H. Riesz

Hall, C. C. PROGRESS REVIEW NO. 7: THE HYDROGENATION AND FISCHER-TROPSCH PROCESSES. *J. Inst. Fuel* (British) 23, 148-151 (1950) *May.*

The progress of the hydrogenation process and of the Fischer-Tropsch process in Germany, England and America is reviewed. Although the hydrogenation process was developed to a high degree in Germany, these plants have since been shut down except for those in Russian-controlled areas. The English plant at Billingham could not be operated economically on coal but has been operated on coal-tar creosote. At present the U.S. Bureau of Mines is the main research organization working on the hydrogenation process. Use of the fluidized catalyst bed appears to be an improvement in the Fischer-Tropsch process. However, cost of preparing synthesis gas is still the most important item and only synthesis gas prepared from natural gas permits competition with crude oil refining. In certain areas of the world, such as the African colonies, India and Australia where cheap coal is available and imported oil is costly, the manufacture of synthetic liquid fuels by the Fischer-Tropsch process may be economical.

C. H. Riesz

Russell, W. W. and Miller, G. H. CATALYTIC HYDROGENATION OF CARBON DIOXIDE TO HIGHER HYDROCARBONS. *J. Am. Chem. Soc.* 72, 2446-2454 (1950) *June.*

Several types of copper-activated, cobalt catalysts were studied for the synthesis of higher hydrocarbons from carbon dioxide and hydrogen at atmospheric pressure and at temperatures of 347 to 572° F. Either alkalizing or heat sintering of the catalyst produced a selective poisoning of hydrogenation centers to increase formation of non-gaseous hydrocarbons. The addition of cerium oxide increased catalyst life and stability. The formation of methane may not involve carbon monoxide as an intermediate since, in all cases, the carbon monoxide in the exit gases was low (below 1-2%).

C. H. Riesz

Sherwood, P. W. HIGH-PRESSURE HYDROGENATION OF CARBONACEOUS MATTER. *Petroleum Refiner* 29, 123-127 (1950) *May.*

Residue processing is probably the most crucial step in the hydrogenation of coal. Standard industrial practice has been to centrifuge the heavy-oil-let-down followed by low-temperature carbonization of the centrifuged residue. Equipment for these steps are described, as well as other methods, including filtrations. Recovery of gases and various liquid products from phase hydrogenation are discussed. Hydrogenation at high temperatures and moderate pressures, possibly using a fluidized bed, may offer alternate methods for hydrogenating coal into gaseous as well as liquid products.

C. H. Riesz

## Iso-Synthesis

Pichler, H. and Ziesecke, K. H. THE ISO-SYNTHESIS. U.S. Bureau of Mines Bulletin 488 (1950).

A manuscript describing an investigation of the synthesis of branched-chain hydrocarbons at the Kaiser Wilhelm Institute for Coal Research has been translated by R. Brinkley and revised technically by N. Golumbic, both of the Synthetic Liquid Fuels branch of the U.S. Bureau of Mines. Initially it was found that thoria was a specific catalyst for the formation of isoparaffins at elevated pressures and temperatures. Investigation revealed that alumina was the best promoter, temperatures of 400 to 450° C and pressures of 300 to 600 atmospheres gave the optimum formation of isoparaffins. Zinc oxide also was found to be a satisfactory promoter, iron was definitely deleterious, and chromium oxide or molybdenum oxide promoted formation of cyclic paraffins. At temperatures higher than the specified range, gaseous hydrocarbons and carbon were formed. At pressures in the range of 600 to 1000 atmospheres, dimethyl ether was found. The most likely mechanism for isosynthesis appears to be the direct formation of branched-chain hydrocarbons.

C. H. Riesz

### Oxidation

Corner, E. S., McGee, R. V. J. and Lynch, C. S. (assigned to Standard Oil Development Co.) OXYGEN CARRIER FOR THE OXIDATION OF GASEOUS HYDROCARBONS. U.S. 2,507,-502 (1950) May 16.

For the oxidation of gaseous hydrocarbons, such as methane or mixtures thereof, an oxygen carrier is claimed which is mainly titania ($TiO_2$) in the amount of 90 to 97%, the remainder being oxides of metals selected from the group iron, manganese, chromium, nickel and tungsten.

C. H. Riesz

### Physical Constants

PHYSICAL CONSTANTS USEFUL IN PETROLEUM REFINING. *Petroleum Refiner* 29, 116-117 (1950) *May.*

A table of physical properties of the common low molecular weight hydrocarbons and of miscellaneous gases and solvents is presented. Original sources for these data are not given and a check of the heats of combustion revealed that for some the ideal gas law was assumed while for others compressibility was taken into consideration.

H. R. Linden

The following articles, the abstracts for which appear on the pages indicated, are also called to your attention:

Crentz, W. L., Doherty, J. D. and Donath, E. E. COAL PREPARATION FOR SYNTHETIC LIQUID FUELS. p. 124

Schroeder, W. C. SYNTHETIC FUEL PRODUCTION. p. 122

## 7. ANALYTICAL METHODS AND TESTS

### Analyzer

Fearon, R. E. (assigned to Stanolind Oil & Gas Co.) GAS ANALYSIS. U.S. 2,499,020 (1950) February 28.

Apparatus and method are described for determining the composition of gaseous mixtures by application of the principles of molecular diffusion.

H. Hakewill

### Carbon and Hydrogen

Naughton, J. J. and Frodyma, M. M. MICRODETERMINATION OF CARBON AND HYDROGEN IN ORGANIC COMPOUNDS. *Anal. Chem.* 22, 711-714 (1950) *May.*

An apparatus and method for the determination of carbon and hydrogen in microsamples of organic compounds are described. The method consists of combustion of the sample in a modified Pregl apparatus, collection of the resulting water vapor and carbon dioxide in a dry ice trap and a liquid air trap, respectively, and, after pumping out the excess oxygen, determination of the water vapor and carbon dioxide manometrically in standard volumes. An analysis of a simple substance can be completed in 16 minutes, whereas a slight procedural modification necessary for nitrogen-containing compounds lengthens the determinations to 23 minutes. The accuracy attainable for the determination of carbon is comparable, and of the hydrogen, superior, to the accuracy of the Pregl carbon-hydrogen method.

Authors' abstract

### Glycol Concentrations

Porter, J. A. and Reid, L. S. A METHOD FOR THE DETERMINATION OF GLYCOL CONCENTRATIONS IN WATER SOLUTION. *Petroleum Engr.* 22D, 9-11 (1950) *May.*

A rapid procedure for determining the concentration of diethylene or triethylene glycol in water solution by means of viscosity measurements has been devised. An accuracy of $\pm 0.5\%$ is claimed for the method.

H. Hakewill

### Review

Edwards, A. H. PROGRESS REVIEW NO. 8: SAMPLING, ANALYSIS AND TESTING OF SOLID, LIQUID AND GASEOUS FUELS. *J. Inst. Fuel* (British) 23, 152-156 (1950) *May.*

Sampling of coal and coke and determination of moisture, ash, mineral matter, sulfur, and reactivity of coal and coke, fuel oils and fuels for gas turbines are discussed under liquid fuels. Gas analysis apparatus and determination of moisture, carbon dioxide, carbon monoxide, oxygen, sulfur, calorific value, and flue gas composition are discussed under gaseous fuels. A total of 58 recent literature references pertinent to the topics discussed are cited.

H. Hakewill

### Sulfur

Wilson, H. N. and Straw, H. T. THE DETERMINATION OF SMALL AMOUNTS OF SULFUR IN ORGANIC COMPOUNDS. *J. Soc. Chem. Ind.* (British) 69, 79-82 (1950) *March.*

A method is described for determining sulfur in organic compounds by air-oxidation at 1000°C over a catalyst composed of vanadium pentoxide on activated alumina. Oxides of sulfur formed are absorbed in either 2% hydrogen peroxide solution or 2% hypobromite solution and are precipitated and weighed as barium sulfate; or in the absence of halogens and appreciable nitrogen, are titrated with 0.02N sodium hydroxide using methyl red as indicator. This procedure has been successfully applied for the analysis of sulfur in gasoline, octane, benzene, toluene, xylene, cresol, xylenols, creosote oil, sperm oil, furfuraldehyde, chlorobenzene, nitrobenzene, pyridine, and lower aliphatic alcohols. Solids can be handled by dissolving them in pure methanol, ethanol, or octane. For sulfur contents between 0.001 and 0.100% it is claimed that the reproducibility of the method is better than ±5%.

H. Hakewill

### Water Content

Hanna, W. S. and Johnson, A. B. WATER CONTENT OF HYDROCARBONS. *Anal. Chem.* 22, 555-558 (1950) *April.*

A modification of the Karl Fischer method applicable to the determination of water in hydrocarbons or petroleum fractions is described. The method involves extraction of the water from the hydrocarbon by dry ethylene glycol and subsequent titration of the glycol extract with Fischer reagent. Under normal conditions, over 90% of the water present is absorbed in one extraction. The method is elastic in that, when properly used, equally accurate determinations can be made on very dry or relatively very wet stocks.

Authors' abstract

## 8. GENERAL AND PHYSICAL CHEMISTRY

### Oxygen

Hoge, H. J. VAPOR PRESSURE AND FIXED POINTS OF OXYGEN AND HEAT CAPACITY IN THE CRITICAL REGION. *J. Research Natl. Bur. Standards* 44, 321-344 (1950) *March.*

The vapor pressure of oxygen has been redetermined between the triple point and the critical point. The critical temperature and pressure have been reported as 154.78°K and 50.14 atm. The triple point lies at 54.363°K and 1.14 mm Hg. The two solid-solid transition points were determined and several determinations of the heat capacity of oxygen near the critical point are reported. Experimental procedures are described very fully.

S. Katz

### Permeability

Weller, S. and Steiner, W.A. SEPARATION OF GASES BY FRACTIONAL PERMEATION THROUGH MEMBRANES. *J. Applied Physics* 21, 279-283 (1950) *April.*

An experimental and theoretical study has been made of the permeability of various gases through very thin films. The films studied have included rubber and rubber-like plastics, ethyl cellulose, polyethylene, cellulose acetate, etc.

There are indications that the process might be of practical importance in the separation of oxygen from air, helium from natural gas and hydrogen from coke oven gas.

S. Katz

## Spectroscopy

Forziati, A. F. REFRACTIVE INDEX AS A FUNCTION OF WAVELENGTH FOR SIXTY API-NBS HYDROCARBONS. *J. Research Natl. Bur. Standards* **44**, 373-385 (1950) *April.*

Refractive indices have been measured for sixty hydrocarbons at 20°, 25° and 30° C and five wave lengths in the visible region. The results are tabulated in detail and are also listed in terms of the constants of the Cauchy and Hartmann formulae.

S. Katz

Francis, S. A. ABSOLUTE INTENSITIES OF CHARACTERISTIC INFRA-RED ABSORPTION BANDS OF ALIPHATIC HYDROCARBONS. *J. Chem. Phys.* **18**, 861-865 (1950) *June.*

Absolute intensities of the 2900, 1460, and 1370 $cm^{-1}$ infrared absorption bands were obtained by integration for twelve hydrocarbons. Intensities of the unit structural groups $CH_3$, $CH_2$ and CH, and the CH bond dipole moment were calculated.

D. V. Kniebes

## Thermodynamics

Gilmont, R., Weinman, E. A., Kramer, F., Miller, E., Hashmall, F. and Othmer, D. F. THERMODYNAMIC CORRELATION OF VAPOR-LIQUID EQUILIBRIA. *Ind. Eng. Chem.* **42**, 120-126 (1950) *January.*

A method of correlating vapor-liquid equilibria data for binary systems is described. Activity coefficients are determined from relative volatilities, permitting the use of a correlation which does not require a knowledge of boiling points. Methods of setting up relative volatility relations and their transformation to activity coefficient relations are described. Detailed examples are worked out in the paper.

S. Katz

Marshall, A. L. and Norton, F. J. CARBON VAPOR PRESSURE AND HEAT OF VAPORIZATION. *J. Am. Chem. Soc.* **72**, 2166-2171 (1950) *May.*

Vapor pressures and heats of vaporization of carbon were computed from sublimation studies. A value of $\Delta H_0^\circ$ of 175.2 K cal per mole is reported. Vapor pressures between 2350 and 2870°K are listed and the free energy function, $-(F^\circ - E_0^\circ)/T$ is given for graphite between 1000 and 4800°K.

S. Katz

Sage, B. H. STATUS OF THERMODYNAMICS IN THE PETROLEUM INDUSTRY. *Ind. Eng. Chem.* **42**, 631-639 (1950) *April.*

Very large amounts of tabulated data are required in predicting thermodynamic properties of multicomponent mixtures and it becomes too cumbersome for practical use; however, by using an equation of state and a digital type computer, it is possible to obtain these properties more readily. The article gives some references to persons who have used this method. Also there are two tables of references where thermodynamic properties for various primary and binary mixtures of lighter paraffin hydrocarbons may be obtained.

S. Mori

The following articles, the abstracts for which appear on the pages indicated, are also called to your attention:

Arthur, J. R. SOME REACTIONS OF ATOMIC HYDROGEN IN FLAMES. p. 123

Reiter, S. H. and Wright, C. C. STABILITY OF BURNER FLAMES WITH PROPANE-HYDROGEN MIXTURES. p. 123

## 10. CHEMICAL ENGINEERING

### Absorption

Danckwerts, P. V. ABSORPTION BY SIMULTANEOUS DIFFUSION AND CHEMICAL REACTION. *Trans. Faraday Soc.* (British) **46**, 300-304 (1950) *April.*

The author presents a solution of the continuity equation for diffusion where a chemical reaction acts as a sink. The case of a pure component and the case of a binary mixture are solved, assuming a first order reaction. For the binary mixture, only one material is considered as being depleted by the reaction. Material flow in one direction and an infinite slab is the case considered.

R. Peck

### Diffusion

Bernard, R. A. and Wilhelm, R. H. TURBULENT DIFFUSION IN FIXED BEDS OF PACKED SOLIDS. *Chem. Eng. Progress* **46**, 233-244 (1950) *May.*

The authors present data for the evaluation of eddy diffusivity for fluids in packed beds. At steady state the partial differential equation for diffusion-convection is set up and solved for the case of a point source. The parameters in the solution are evaluated for the case of an infinite solid and the case of a wall boundary. Considerable data were presented by plotting a Peclet group $D_p a / E$ as a function of a Reynolds number. Pressure drop through packed beds is presented by plotting the friction factor as a function of the Reynolds number. The curves show the gradual transition from viscous to turbulent conditions in packed beds.

R. Peck

Fairbanks, D. F. and Wilke, C. R. DIFFUSION COEFFICIENTS IN MULTICOMPONENT (1950) *March.*

Experimental study of the diffusion of vapors into multicomponent gases substantiates an equation previously derived by Wilke on the basis of theories of Maxwell and of Stefan.

J. D. Parent

### Distillation

Bubb, F. W., Nisle, R. G. and Carpenter, P. G. AN ELECTRONIC ANALOG COMPUTER FOR SOLVING THE FLASH VAPORIZATION EQUILIBRIUM EQUATION. T. P. 2853. *Trans. A. I. M. E.* **189**, 143-148, *J. Petroleum Technol.* **2** (1950) *May.*

An electronic analog computer is described which provides solutions to the vapor-liquid equilibrium problem for systems involving up to seven components. Included with the description of the instrument is a list of other applications, including determination of optimum separator operating conditions, evaluation of reservoir reserves, natural gasoline plant calculations and estimations of vapor-liquid equilibrium constants.

S. Katz

Chu, J. C. BATCH RECTIFICATION. *Chem. Eng. Progress* **46**, 215-220 (1950) *May.*

With the application of Smoker's equation and Eshaya's method respectively, analytical expressions are derived for binary mixtures giving the yield of distillate of a given composition obtainable by batch fractionation of a given charge in both an ideal column and a column with holdup. It is assumed that the reflex ratio is continuously increased throughout the rectification to maintain the product composition constant with a finite reflux ratio at the cutting point. The equations derived are applicable to complex mixtures if the effective binary system as proposed by Hengstebeck is employed.

Author's abstract

Reed, T. M. and Fenske, M. R. HYDRODYNAMICS OF LIQUID-VAPOR FLOW IN PACKED DISTILLATION COLUMNS. *Ind. Eng. Chem.* **42**, 654-660 (1950) *April.*

An expression for pressure drop in packed distillation columns is derived and checked experimentally with fair success.

J. D. Parent

### Heat Transfer

Bromley, L. A. HEAT TRANSFER IN STABLE FILM BOILING. *Chem. Eng. Progress* **46**, 221-227 (1950) *May*.

Equations are derived for heat transfer coefficients in film boiling on vertical tubes and vertical plane surfaces. Considerable data are presented to show the accuracy of the equations. The effects of surface tension, agitation, temperature of the liquid bath and the diameter of the tubes on the coefficients are discussed.

R. Peck

### Mass Transfer

Linton, W. H., Jr. and Sherwood, T. K. MASS TRANSFER FROM SOLID SHAPES TO WATER IN STREAMLINE AND TURBULENT FLOW. *Chem. Eng. Progress* **46**, 258-264 (1950) *May*.

Data are presented to show that mass transfer coefficients can be correlated with the Schmidt and Reynolds groups. Diffusion of benzoic acid, cinnamic acid and beta naphthol into water was studied. Results confirm the previous experiments where the diffusion was found to vary as the Schmidt number to the two-thirds fewer when the fluid is in turbulent flow. Results in streamline flow agree with the Leveque equation within the experimental error.

R. Peck

### Phase Equilibria

Glanville, J. W., Sage, B. H. and Lacey, W. N. VOLUMETRIC AND PHASE BEHAVIOR OF PROPANE-BENZENE SYSTEM. *Ind. Eng. Chem.* **42**, 508-513 (1950) *March*.

The specific volume of mixtures of propane and benzene was determined at pressures from approximately 100 to 10,000 pounds per sq. in. absolute at seven temperatures between 40° and 460°F. The composition of the dew-point gas was measured at five temperatures between 10° and 460°F for pressures between the vapor pressure of benzene and the critical pressure of the system. The results are presented in tabular form, with a limited number of illustrative diagrams.

Authors' abstract

Reamer, H. H., Sage, B. H. and Lacey, W. N. PHASE EQUILIBRIA IN HYDROCARBON SYSTEMS. *Ind. Eng. Chem.* **42**, 534-539 (1950) *March*.

Measurements of the molal volume of four mixtures of methane and propane were made at pressures up to 10,000 pounds per sq. in. and at temperatures from 40° to 460°F. The composition of the coexisting phases was determined throughout the two-phase region at temperatures above 40°F. These results supplement earlier measurements upon this binary hydrocarbon system which were made over a smaller range of pressure and temperature. The results of the two sets of measurements are compared.

Authors' abstract

## 11. PROCESS EQUIPMENT AND INSTRUMENTATION

### Control Valves

THE REFINER'S NOTEBOOK. CONTROL VALVE CHARACTERISTICS. *Oil Gas J.* **49**, 103 (1950) *May* 11.

Valves may be classified as quick opening, linear characteristic and equal percentage. In the quick opening type, maximum flow is obtained with low lift of the valve stem. In the linear type an increase in flow is directly proportional to increase in valve lift. In the equal percentage type, the change in flow per unit change in valve lift keeps increasing over the range from closed to fully open.

W. J. Merwin

THE REFINER'S NOTEBOOK. CONTROL-VALVE PRESSURE DROP. *Oil Gas J.* **49**, 87 (1950) *June* 1.

Where process conditions are such that there is substantially constant pressure drop across the valve, the valve is sized for maximum flow conditions. Where the pressure drop across the valve is variable, the effective characteristics of the valve in the particular installation must be evaluated. Where information is not available to do this, the general rule is to size the valve for a pressure drop which is at least 15% of the total pressure drop in the system.

W. J. Merwin

THE REFINER'S NOTEBOOK. CONTROL-VALVE FLOW RATES. *Oil Gas J.* **49**, 161 (1950) *May* 25.

Control valves are sized according to several general rules: (1) the nominal valve size is selected to be one or more sizes smaller than the line size; (2) the valve is made large enough to handle twice the normal flow when wide open; (3) the valve is sized to handle normal flow at 60-75% of maximum flow through the valve. Some general comments as to selection of control valves are made with reference to a fractionating tower.

W. J. Merwin

### Expansion Joints

Wolosewick, F. E. EXPANSION JOINTS AND THEIR APPLICATION. *Petroleum Refiner* **29**, 146-150 (1950) *May*.

Expansion joints are made up of corrugated metals or have a sleeve which slides in a cylinder. The corrugated joint may be the hinged type which permits angular rotation or the displacement type which absorbs longitudinal displacement. Bellows are made of thin corrugated elements which must be able to absorb longitudinal expansions by flexure of the bellows, must withstand the internal pressure and must be able to absorb some transverse displacement.

W. J. Merwin

### Flanges

Blick, R. G. BENDING MOMENTS AND LEAKAGE AT FLANGED JOINTS. PART II. *Petroleum Refiner* **29**, 119-122 (1950) *May*.

Equations are presented which enable calculating the moment capacity of a flange. This is plotted against the working pressure and a leakage envelope is obtained, inside of which leakage is improbable.

W. J. Merwin

### Meters

Taylor, J. B., Jr. FUNDAMENTALS OF ORIFICE METER MEASUREMENT. *Instruments* **23**, 518-520 (1950) *May*.

The physical basis for measurement of flow with an orifice meter is presented in an elementary manner. The effect of pressure temperature and specific gravity on gas metering with orifice meters is illustrated with simple examples.

O. T. Bloomer

### Open-Box Coolers

Draughon, C. R., Jr. and McNeil, E. B. DESIGN OF CATHODIC PROTECTION FOR OPEN-BOX TYPE COOLERS. *Petroleum Refiner* **29**, 97-103 (1950) *May*; *Oil Gas J.*, **49**, 76-78, 80, 82 (1950) *June* 1.

An effective program of cathodic corrosion control on the water side of open-box coolers has been achieved for systems using recirculated well water and raw river water. The cathodic protection installations were made at a cost of one third that of replacement and maintenance costs have been reduced to 10% of the pre-protection costs. Design details and important pipe potentials are given.

B. E. Hunt

## 12. MATERIALS OF CONSTRUCTION

### Refractories

Patrick, E. A. K. NEW REFRACTORIES AND INSULATING MATERIALS. *Gas* (British) **261**, 711-712, 717 (1950) *March* 22.

Recent trends in the development of insulating and refractory materials is described briefly at three different temperature ranges. At low temperatures, mild steel may be protected by coating it with a refractory enamel; then the surface temperature may be increased from 650 to 1150° F. In the medium range, (1300° F) the mechanically weak insulators like asbestos, magnesia, and diatomaceous earth may be replaced by vermiculite, which when heated, becomes quite resistant to mechanical shock. At higher temperatures up to 1550° C where the weak strength refractories must be used, ethyl silicate may be coated on the hot surface side of the refractories and glazed to a hard silica coating.

S. Mori

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